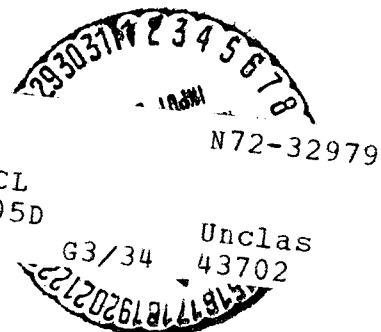


THE PLANET'S FIRST COSMONAUT

G. S. Titov

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THE PLANET'S FIRST COSMONAUT

German Stepanovich Titov

ABSTRACT. The preparation for flight, the tense wait at the space port, the take-off, the rejoicing of all people on Earth: a man has penetrated into the cosmos for the first time, a citizen of the Soviet Union, major Yuriy Alekseyevich Gagarin. This is the beginning of the tale about the planet's first cosmonaut, as told by cosmonaut No. 2, German Titov.

A friend and comrade-in-arms of Yuriy Gagarin, German Titov worked together with him for many long years, carried on together with him socially important work in preparing cosmonauts for future flights. His reminiscences, on which this pamphlet was based, will be of interest to the widest readership.

Yuriy Alekseyevich Gagarin is one of the most beloved and /3*
glorious sons of the people. His life is similar to the lives of many Soviet people. But what makes the heroes of our days strong also makes them great — the fact that they are always and in every way inseparable from their people. "Would I have been able to penetrate into the cosmos if I were alone?" he said. "Thousands of Soviet people worked to build the rocket and spacecraft on which I was assigned to fly. And this flight is a triumph of the collective thought, the collective work of thousands of Soviet workers, engineers, scientists. It is a glory of our people."

He spoke with great warmth and sincerity about the people who educated and raised him. He did not conceal the fact that service in the Armed Forces and in our Air Force had given him a great deal. "In the army I met many people with a party character, who were straightforward and honorable, who related themselves to business

*Numbers in the margin indicate pagination in the original foreign text.

from a governmental point of view. These people wear overcoats and aviator jackets, but in nature they are working people. They love work and hate shirkers; they are able to see in work the poetry of life, its meaning. And I thank them for this. They taught me how to work in the right way, both on earth and in the air."

He went through his "space" preparation in the first group of cosmonauts. During his studies, Yuriy was always ready for the most difficult assignments. No matter whether this had to do with flights in a state of weightlessness, with training sessions on the centrifuge, prolonged periods of time spent in the anechoic chamber, or parachute jumps — he always proposed: "May I be first?"

Naturally, all of us prepared ourselves obstinately for space flights, we prepared in the Gagarin manner. We did not spare ourselves efforts or time. We worked tirelessly, helping each other.

.....The last days were going by before man's flight into the cosmos. The question was being decided: to whose lot would fall the great honor of taking his place in the cabin of the spacecraft. Naturally, each one of us was burning with the desire to be the first discoverer.

Yuriy Gagarin will be the one — that was our general opinion. We knew that he was a good comrade, a principled, honorable communist who was greatly respected. I frequently had many opportunities to work together with Yuriy in solving various aviation tasks, and it /4 was also my opportunity to obtain my degree at the N. Ye. Zhukovskiy Academy. I would like to avoid the hackneyed words: "I was surprised" or "I was pleased." Let me say instead: with Yuriy one could do anything well and calmly, and rely on his friendship. With him, I always felt myself at ease and simple in any situation, in any company, in a conversation on any subject.

His ability to enter, to "join" a collective, an environment, to be himself everywhere, appealed to me. I tried to emulate Yuriy,

but I did not always succeed. The difference in our characters did not prevent us from being good comrades.



Figure 1. Aviator-cosmonaut of the USSR, Hero of the Soviet Union, colonel Yuriy Alekseyevich Gagarin.

We lived in adjoining rooms. Yuriy's daughter Lena was born when they were still living in the North, and my Tamara was getting ready to become a mother. All of this brought us still closer to each other.

I remember well the day when it became clear that I was to be Gagarin's back-up man. Need I say how proud I was of the trust placed in me? Even before that, we happened to be in one of the factories.

Sergey Pavlovich Korolev, who was in charge of building the launch vehicle and the spacecraft, greeted us graciously. His attentive gaze and confident, unhurried speech revealed great intelligence and will power.

With mental trepidation we went toward the spacecraft. Everything here was new to us. For some reason, I recalled that this was exactly how we felt as students when we first went near a jet-propelled aircraft, although externally the spacecraft Vostok had nothing in common with an airplane. Examining the craft, we noticed the windows, and someone said that there ought to be a good view from the cabin. Sergey Pavlovich briefly explained the structure of the craft and the launch vehicle.

"Look," he said, "the craft is covered with a heat-resistant shell. During descent, when the spacecraft enters the dense layers of the atmosphere, the cosmonaut will look through the windows and see a raging flame on the spacecraft's surface. The spacecraft will be subjected to a heat flux of several thousands of degrees! But inside the cabin the temperature will not exceed twenty degrees. The window glass is also heat resistant."

Korolev explained to us the structure of the spacecraft cabin, the purposes and operating principles of the equipment and the instruments. The cabin was much more spacious than the cabin of a jet fighter. At the same time, here there were fewer instruments, buttons, and tumbler switches. The control of the spacecraft had been automated in many respects.

Listening to the explanations of Sergey Pavlovich, we realized how much had been done to give all the units and mechanisms a high reliability and, consequently, to protect the flight safety.

At the end of his talk, Korolev said: be the masters on board the craft, study it creatively, make your own suggestions — it is you who will fly in it! /6

And we began to make a profound study of the spacecraft, to master its numerous, complex systems and units. This is where all our previously acquired knowledge was needed. But it turned out that this knowledge was meager for preparing for flight in a spacecraft. The engineers and designers treated the cosmonauts very considerately. We carefully heard and remembered their explanations, and when we had finished most of our study and began to make the spacecraft our "home," so to speak, a number of wishes and suggestions occurred to us.

"Express your judgments boldly, make suggestions!" said Korolev.

We made several suggestions about how to make the spacecraft more comfortable. Sergey Pavlovich, familiarizing himself with them, observed: "Very sensible advice..."

Soon after, when we were at the space base again, we were brought to the spacecraft and invited into the cabin.

"How is it now? Is it better?" asked the designers.

Who would not be happy to see that he had been able to make his own contribution to an immense project presided over by designers, engineers, technicians, and workers! My friends also had the chance to know this happiness. We had the feeling that we had been able to enter into the creative collective which was creating the spacecraft, not as outside observers, and this made us happy.

The flight into the unknown approached nearer and nearer. In spite of the careful preparation, this flight was fraught with a certain risk. And probably there would not be anyone on Earth who would be able to take off into space with absolute serenity.

Not long before the flight, Chief Marshal Vershinin of the Air Force again spoke with us. Konstantin Andreyevich was interested in everything which had to do with the flight and, naturally, in the

state of our morale before everything else.

"Are you excited? Are you nervous" he sympathetically asked Yuriy Alekseyevich.

"A little, comrade Chief Marshal," admitted Gagarin.

"It's not noticeable from your appearance. That means that you are hiding your excitement here," he said, moving his hand to the left side of his tunic, where there were glowing the many-colored ribbons of his decorations.

"I will hold out, comrade Chief Marshal. I will be able to manage," Yuriy Alekseyevich assured him.

"The most important thing is confidence," said Konstantin Andreyevich, "confidence in yourself, in technology, and then you will emerge victoriously from the most complex situation."

We were confident in success, confident in the capacities of Soviet people, who had prepared the first flight into space.

Konstantin Eduardovich Tsiolkovski wrote many years ago: "At 17 the beginning inevitably are thoughts, phantasies, tales. They are followed by scientific calculation. And only at the very end are the thoughts crowned by fulfilment." We were the witnesses of the fulfilment of the boldest creative thoughts. Yuriy Gagarin was to take off into space only after scientists had gained full confidence that he would return to Earth alive and healthy.

Before departure, we had a party meeting at the space port. The agenda was laconic: "How I am ready to carry out the command of the Fatherland." The cosmonauts swore to the Fatherland, to the Communist Party, to the Soviet Government, and to their fellow communists that they would carry out the assignment honorably. All of them listened, holding their breath, to the talk of Yuriy Gagarin.

TEXT "I am happy and proud to have been among the number of the first cosmonauts. I will spare no pains nor effort, will stop at nothing, in order to carry out worthily the assignment of the Party and Government. I join with the many collectives of scientists and workers who created the spacecraft and dedicated it to the Twenty-second Congress of the CPSU," he said.

I was next called upon to speak.

"I know that many of my comrades can take part in the space flight. But if the Party and the Government entrust it to me, I will /8 devote all my ability to carrying out splendidly the honorable assignment," I said.

In spired and full of energy, we came back from the meeting. There were no difficulties, it seemed, that we would not be able to overcome.

At long last, the long-awaited day arrived. We departed for the Baykonur space port; our relatives and families also were excited. I saw how excited was Tamara during the last days before our departure for the space port, and thought: "Her sorrow from the death of our little son has not yet abated, and now there is more excitement. How much do you have to go through, our dear friends!"



Figure 2. Yuriy Gagarin during his student years at the Saratov Aviation Club

Thus, we were at the space port. The bright morning of April 12, 1961. The sun has scarcely appeared beyond the far-off horizon, but its rays were already warm and caressing. The bus let us out at the foot of the rocket. In a few minutes Gagarin would take his place in the cabin of the spacecraft. He was warmly taking his leave of the members of the State Commission, the scientists, his fellow cosmonauts. We were both wearing spacesuits, but we also embraced and, as we customarily say, "clinked" our pressure helmets together.

"Dear friends, both near and unknown, fellow-countrymen, people of all lands and continents!" said Yuriy Gagarin to those who had come to see him off. "In a few minutes the mighty spacecraft will carry me off into the distance spaces of the Universe. What could I say to you in these final minutes before the take-off? My whole life seems to me now one beautiful instant....."

Everything which he had lived through, he continued, everything that he had done before, had been lived through and done for the sake of this minute. You understand yourselves how difficult it was to get a clear understanding of our feelings now when the test for which we had prepared so long and passionately was not very close at hand....

In Yuriy's voice there was solemnity and excitement.

It was not I who was to fly. I was the stand-by, or the back-up man, as they began to call it later. But it seemed as if the words of my friend, to whose lot had fallen the honor of being the first to fly, came out of my own heart. He spoke of the responsibility which had fallen to the lot of the cosmonaut before the Soviet people, before mankind, before its present and future.

"And if I nevertheless decide to make this flight," continued Yuriy Gagarin, "it is only because I am a communist, because I have behind me examples of the unparalleled heroism of my fellow countrymen, the Soviet people. I know that I will concentrate all my will-power for the best possible fulfillment of the assignment. Understanding the responsibility of the task, I will do everything in my

power to carry out the assignment of the Communist Party and the Soviet people."

We had no doubt that Yuriy would do everything....

Gagarin got into the elevator, and it took him to the platform located by the entrance of the spacecraft. He raised his hand, saying good-bye again: /9

"Until we meet again soon!"

The hatch slammed shut. And we, as if spellbound, still kept standing by the launching pad.

When Yuriy reported: "I feel well. I'm ready for take-off," I went to change clothes. I quickly took off the spacesuit, the pressure helmet, the overalls, put on "earthly" clothing, and went to the communication center. Here were my comrades, the other cosmonauts. We could hear by relay the conversations between the chief designer and Yuriy as the machinery was being prepared for take-off. Over the dynamic loudspeaker there rang out the confident, somewhat jocular voice of Gagarin:

"I feel excellent. I am doing everything the way you taught me."

We involuntarily broke out laughing. And this was why: once a cosmonaut jokes, this means that he really feels splendid.

The command rang out:

"Lift-off!"

The first take-off of the first spacecraft in the world with a human being on board! A majestic, imposing picture! The engines began to roar, and the foot of the rocket was shrouded in clouds of smoke. With every second the drone of the engines increased, and the



Figure 3. Yuriy Gagarin and his wife Valentina
and daughter Lenchka

cloud of smoke became thicker and vaster. By now it already covered a good half of the rocket body. Below, a sea of smoke and fire was raging. And now the rocket, having lurched slightly, began to sail slowly upwards. Have a good flight, dear friend!

I am often asked: "What did you feel when Gagarin took off?"

My feelings and thoughts before and during the flight of Yuriy Gagarin could be compared in some degree with the thoughts and feelings of an aviator who has seen off his comrade on the first flight in a new airplane. Usually during such a flight, the aviators remaining on the ground carefully follow his actions, the behavior of the airplane at take-off and landing, take note of everything, and reach their own conclusions. This was how it was with me before and during Gagarin's flight. At the moment of the direct preparation of the rocket for take-off, I was absorbed by the technical side of the matter and was following the sequence of commands and the reports of the cosmonaut. When the rocket had left the launching pad and was rushing upwards, I carefully followed the operation of the control engines, which enabled the rocket to fly along the prescribed trajectory.

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After the take-off, the space port somewhat became empty. We aviators are also acquainted with this feeling. How many times had your comrade been standing by your side at the airport talking with you, and now he was far away from you. How is he now? How will he be in a minute or two? These questions, and the feeling of anxiety over the outcome of the flight, are understandable to everyone.

To speak frankly, there simply wasn't time then to think of the whole immensity of the world's first space flight. Hardly had the powerful drone of the rocket died away before I and Nikolay Petrovich Kamanin were in an airplane. We were flying towards the landing area. It was a shame to leave the communication center, but Nikolay Petrovich said:

"There will be communications there, too."

The airplane smoothly left the concrete and gained altitude. We had not left the loudspeaker and could hear what was going on in the air. Listening to the communications from space, we involuntarily compared our own conjectures with what was taking place at that time in the flight. In the broadcasts of the first cosmonaut, we caught details and small items which were understandable only to specialists, to those who had, like Yuriy, prepared for the flight. After the take-off, the speed of the rocket increases quickly, and the g-loads also increase. Aviators, especially of fighters, also experience them in flight. When maneuvering the airplace, it seems as if someone is pressing you onto the seat with immense power. But yet, it is harder for a cosmonaut. It is harder, not because the g-loads are more intense in a flight in a spacecraft. They continue to operate for a longer interval of time.

Can man withstand them? Our scientists, after launching animals into space, came to the conclusion that a trained man, if he is in a definite position, can endure the g-loads occurring during rocket flight. But would these conclusions be confirmed in practice? The news from the spacecraft was joyful: Yuriy was able to endure the g-loads well.

The time was approaching when the space rocket would go through the dense layers of the atmosphere. After this, the nose fairing would be jettisoned. That is why we were waiting excitedly for the automated instruments to operate. At long last, the cosmonaut announced: /11

"Nose fairing jettisoned. I see the Earth!"

"It worked!"

As the fuel was used and the speed increased, the rocket stages were detached one after another. We heard the short report of the cosmonaut. Yuriy reported that the spacecraft had gone into orbit. Weightlessness began. How would he be able to withstand it? All our attention was riveted to the broadcasts from space. How is Yuriy feeling?

I had read a great deal about weightlessness; as a fighter pilot I was acquainted with this state to a certain degree. It can occur at definite times during a flight, for instance, when the plane is "hovering," as the pilots express it. We had also experienced weightlessness for a short time during the preparations for the space flight. And yet....

Living on the Earth, man is constantly under the influence of the force of gravity. Developing under these conditions, our organism adapts to them; the heart functions with a definite load; man senses his spatial position; he knows which is "up" and which is "down"; he can move about normally, sit down normally, rest normally.

In his fantastic story called "Daydreams about Earth and Sky," Konstantin Eduardovich Tsiolkovski depicted the state of man under conditions of weightlessness. He wrote: "I traveled in the air to all corners of the room from the ceiling to the floor and back again; I did somersaults in space like a clown, but involuntarily bumped into all objects and with all my limbs, bringing into motion everything

which was hit.....It seemed to me all the time that I was falling... ..Water poured out of the pitcher because of a jolt and went flying around, first in the form of a wavering ball, then later, upon being struck, broke up into drops. Finally, it stuck together and went crawling off along the walls.....In such a medium, a body which has no motion never acquires it except for the action of a force; on the contrary, if a body has motion, it retains it forever."

This was spoken in a fantastic story. But what would it be like in reality? This question was answered from space for us by Yuriy Gagarin.

"The flight is going ahead successfully. I feel well. All instruments, all systems are operating well."

He was successfully carrying out the program, and weightlessness was not interfering with his activity. Tsiolkovski was right again here when he said that the lack of gravity would be endured by man for any arbitrary duration of time without any bad consequences.

Another very important problem which was solved during Gagarin's flight is the operation of the automated equipment. The whole flight is the operation of the automated equipment. The whole flight of the space rocket, the operation of all of its complex mechanisms was controlled by automatic systems. They guided the rocket along the assigned trajectory, controlled the operation of the engines, jettisoned the stages, and at the assigned point put the spacecraft into descent. Automated equipment maintained inside the spacecraft the conditions necessary for human vital activity. We noted with joy that all of the automatic systems were working without failure. /12

From the cosmos more and more messages from Yuriy Gagarin kept coming in:

"Broadcasting the regular report: 9 hours 48 minutes, the flight is going ahead successfully.....I feel well, am in good spirits...."

"Solar-pointing control switched on...."

"The flight is going ahead normally, the orbit is the calculated orbit....."

"Am in good spirits, I continue the flight, I am over America..."

"I see the Earth's horizon. What a beautiful halo!" At the beginning there is a rainbow from the very surface of the Earth, and this rainbow moves downward. Very beautiful...."

Ahead lay the most important and, perhaps, the most complex stage of the flight: disorbiting and landing. Will everything operate normally? Even though the retrosystem and the landing system had been checked many times in flights of spacecrafts with animals aboard, it was still possible that unforeseen circumstances could occur. Will my friend be able to manage if he has to carry out the landing by manual controls? Pictures of our training sessions together flashed through my consciousness.

"Everything will go well," I thought.

At long last the radio announced that the spacecraft Vostok had landed safely at 10 hours 55 minutes. Yuriy Gagarin broadcast from the landing site: "Please inform the Party and the Government that the landing took place normally, I feel well, and I have no traumas or bruises."

The world's first space flight by man had been completed successfully.

When we flew to the landing area, I wanted to rush up and hug Yura, but I saw him surrounded by a dense ring of people. Scientists and academicians were standing around him. There was no possibility of going up to Gagarin. But nevertheless I began to press through the throng. Surprised, stern glances were cast on me, but I moved

further on. Yura noticed me when I was only a few steps from him, and he rushed towards me. We hugged each other strongly, squeezed each other for a long time, not feeling that we were exchanging powerful punches. After resting, Yura and I were rambling along the bank of the Volga. The snow was melting. The earth was drying out a little, here and there the bright-green grass was forcing its way through, and the buds of the trees were already beginning to put out fragrant, sticky little leaves. The alders were covered with dark-red catkins. The ice was breaking up on the mighty Volga. In the branches the rooks were bustling about, fixing up their old nests. The starlings were piping, and all this merged into an entrancing melody, a triumphant hymn to spring. The picture of Russian nature, so dear to the heart. It harmonized amazingly well with our joyful mood. We joked and dreamed of future flights, and Yura shared his impressions with me. /13

I asked him about weightlessness.

"Of course, the sensation is a little unusual, but I didn't feel anything unpleasant. On the contrary, I even experienced a feeling of lightness. I think that one can get used to even this."

Yura thought for a moment.

"What are you thinking about?" I asked him. "Are you dreaming that sometime the two of us, just like this, will be rambling about on the bank of some Martian river or other and admiring the setting sun and the Earth?"

"Wouldn't that be just great?" he laughed.

After that there was the unforgettable welcome in Moscow. Yuriy was standing on the reviewing platform on Lenin's Mausoleum. By him stood the leaders of the Party and Government. Moscow. The jubilant capital. The joy of the whole world at this victory of Man. I and my fellow cosmonauts walking along in the thick ranks of demonstrators. We were crying out loud, applauding, laughing. On the reviewing plat-

form was Yuriy. He caught sight of our group and affably waved his hand.

Over the square resounded the voices of people chanting:

"Glo-ory to the Party! Ga-ga-rin!"

Each day brought joyful news: Yuriy Alekseyevich Gagarin was a Hero of the Soviet Union. The Presidium of the Supreme Soviet awarded the second gold medal of the order of the "Hammer and Sickle" to seven prominent scientists and designers and conferred the title of Hero of Socialist Labor to a group of leading designers, executives, scientists, and workers who had taken part in building and realizing the flight of the spacecraft Vostok. Orders and medals were awarded to about seven thousand workers, designers, scientists, and engineering and technical executives. We also were among those given /14 awards — the cosmonauts of the first recruitment, or, as they began to call it later, the Gagarin recruitment. I was awarded the Order of Lenin.

Now when I return to my past experiences, I feel even more clearly, more vividly the immensity of the events of those days and the role played in them by Yuriy Gagarin. One may say boldly that after April 12, 1961, the day which people of the entire Earth called the dawn of the space era, there was not on our planet any contemporary who was so beloved, not only by his own people, but also by the peoples of the whole world, regardless of nationality, political convictions, and religion. The name of Yuriy Gagarin became the symbol of the space era. His feat embodied all the best which had been created by the human reason. This feat, as is often said, was written with golden letters into history, but it seems to /15 me that even this noble metal is not capable to reflecting its greatness sufficiently.

For us cosmonauts Yuriy Alekseyevich is a brother-in-arms; for many people, he is a close comrade, a sincere and hearty friend.



Figure 4. The first cosmonaut, major Yu. A. Gagarin after the successful touchdown of his spacecraft

We know that he, a little man from Smolensk, had to travel, before his trip to the stars, a big road through life, a road similar to hundreds and thousands of others traveled by young people who are enthralled by a dream and who are seeking something. This is a road which is quite common in our country and which is at the same time quite heroic. The hundred and eight minutes which it took the Vostok to girdle our planet do not tell only about the speed with which the spacecraft flew. They were the first minutes of the space era, and this is why they so staggered the world.

The memory of these minutes will be precious not only to historians.

Our great-grandchildren, our distant descendants will read over and study, with love and respect, the documents about the birth of the new era which opened up the way into the limitless Universe for human beings, the children of Earth.

"Spacecraft Vostok launches major Gagarin into history."
"Man's most imposing achievement." "We must take our hats off to the Russians." Under headlines like these, the world's press reported the achievements of the Soviet people. And it is only natural that, with the completion of his space orbit, there began for Yuriy other orbits, "terrestrial" ones, not only in our country, but also in foreign countries: everyone wanted to see Earth's first cosmonaut.

During the first months after the flight, Yuriy Gagarin had to make speeches at rallies and meetings, to workers and scientists, in schools, in student auditoriums, and to give interviews to a



Figure 5. Academician C. P. Korolev and
Yu. A. Gagarin

numerous and diverse army journalists. And although they never taught us how to do this in our detachment of cosmonauts, Yuriy brilliantly managed also his terrestrial overload. Proof of this is the delighted faces of listeners and the stormy ovations of audiences after his speeches and answers to questions. Yuriy Alekseyevich's ability to orient himself to a situation quickly and freely, his knowledge of space technology, the breadth of his thinking and his erudition brought to our country great advantages in its external politics, and incalculable moral victories to our people.

Yuriy Alekseyevich visited thirty foreign nations. However, the tense social-political activity could not distract Yuriy Alekseyevich from that to which he was most closely connected. He could not remain on the sidelines apart from the preparation of his friends for new take-offs.

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Figure 6. Moscow. The population of the capital greeted with great joy and pride for their Fatherland the news that spacecraft Vostok, with the USSR citizen, aviator Major Yuriy Alekseyevich Gagarin, on board, had gone into orbit and had successfully returned to the Earth. In the photograph: a column of Moscovite students at Manezhnaya square.

Yuriy welcomed each new flight and rejoiced enthusiastically together with all his friends. But we knew that in the depth of his spirit he was sad and envied each one of us: the flights were becoming more and more interesting all the time, and as a professional pilot he could not stay away from this work, although he contributed all of his knowledge and efforts to the preparations and support of each flight. He saw off his friends on their flights into space and experienced each flight together with them; he taught others and learned himself. He dreamt about the time when our vehicles would fly on interplanetary routes, about the day when he himself would sit behind the wheel of a spacecraft. It was in the name of this dream that Yuriy Gagarin performed his space feat; in the name of this dream he worked, and in its name he lived. /16

The world still continued to admire rapturously the feat of the Soviet people, while the cosmonauts continued their everyday affairs: they carefully studied and analyzed the flight experience of Yuriy Gagarin, drew conclusions, trained themselves.

The flight of Yuriy Gagarin shed light on many questions. The designers and doctors tested the equipment for supporting human vital activity under new conditions. The cosmonaut's observations

during flight made it possible to come to new conclusions about the influence of the factors of space flight on the human organism and to work out the most effective techniques of guaranteeing normal conditions of vital activity outside of the confines of Earth. Naturally, all of this was taken into consideration during the preparations for the flight in spacecraft Vostok-2.

The flight showed that man is able to withstand the conditions of space flight, to return safely to Earth, and to maintain fitness for work, coordination of movements, and clearness of thought. At /17 the same time, there arose many questions requiring confirmation, greater precision, and further development.

Soon after Yuriy Gagarin's flight we gathered together in order to hear, in a businesslike atmosphere, our friend tell about his sensations, the conditions of working in space, and the behavior of the spacecraft. All were impatient to hear all of this, so to speak, from the original source.

"At the take-off," recounted Yuriy, "I heard a whistling and a growing hum; I could feel how the craft started to shake, separated itself, and began to pick up speed. The noise and vibration were noticeable."

We listened and caught every word of his, knowing that sooner or later each one of us would have to experience all of this. And Yuriy Alekseyevich told us in detail about his sensations as the g-loads increased; he expressed his opinion about how to behave on the first stage of the flight, how to divide up one's attention during this period, on what to focus special attention during ascent, during landing, and so forth. We were especially interested in what he said about weightlessness. Yuriy Gagarin was the first human being to have really experienced the state of weightlessness for a period of nearly one and a half hours.

"Weightlessness does not have a negative effect on man's fitness

for work," he firmly declared.

Gagarin told in detail about how he worked in the weightless state, how he kept notes in the flight log. All of this was new and interesting.

"What did you see through the window? What does Earth look like?" we asked with great interest.

"I saw the clouds and their shadows on the Earth. The Sun is astonishingly bright; it is impossible to look at it with the naked eye. I even closed the window part way to make the brightness of the rays less powerful."

We were especially interested in the descent, the entry into the dense layers of the atmosphere, and the landing. How must the spacecraft be oriented before descent? What is the best thing to do during its descent? What does man feel upon the transition from weightlessness to the normal state? And I must say that Yuriy Alekseyevich was able to satisfy our curiosity. He told his story unhurriedly, clearly, and graphically.

.....The days and weeks rushed by. Yuriy Alekseyevich made trips to Czechoslovakia, England, and other countries. The world honored the first hero of the cosmos, and we were sincerely happy and proud that this man was a citizen of the Soviet Union. Festive welcomes were organized for him on all the continents, and he always remained true to his words: "There is glory and Glory. And that which one would like to write with a capital letter never was and never will be only your own glory. It belongs before all to the system, the people which raised and nurtured you. And it does not turn your head. This glory makes you be more demanding of yourself; it is difficult but reliable." /18

The first cosmonaut's demandingness of himself was transmitted to his comrades as they prepared for new flights. Our training



Figure 7. Aviator-cosmonauts German Titov and Yuriy Gagarin

incorporated the experiences of Yuriy. When I was already in orbit in spacecraft Vostok-2, Yuriy reminded me of himself from the Earth (he was then in Canada). On the second circuit I received an unusual, unexpected radiogram: my friend Yuriy Gagarin sends me greetings from Canada, where he is a guest on Cyrus Eaton's farm.

"Dear German," said the telegram, "I am with you with all my heart. I hug you, dear friend. I kiss you soundly. With excitement I am following your flight and am confident in a successful conclusion of your flight, which will once more glorify our great Fatherland, our Soviet people. Until we meet again soon!"

And this meeting was approaching. Vostok-2, after completing 17 circuits, began its descent to the Earth. I remembered then how Yuriy Alekseyevich had said that when the craft enters at an immense speed the upper layers of the atmosphere its structure "crackles" under the influence of the overload and the aerodynamic heating. One gets the impression that huge tongues of flame are rushing around the vehicle, licking its skin. According to my calculations, the engine of Vostok-2 gave out the required retrothrust pulse, and the craft went onto the descent trajectory. This was over Africa, and I was to enter the dense layers of the atmosphere somewhere over the Mediterranean. On the globe, the landing zone was marked out in the Saratov region.

STOP HERE

STOP HERE

So as to determine the moment of entry into the upper layers of the atmosphere, I on purpose had not fastened down the photoexponometer, and it was still floating around the cabin on a little string. This was my most sensitive instrument to small overloads. As soon as the atmospheric resistance began to brake the movement of the craft, the photoexponometer box began to move slowly towards the cabin floor. That meant that the descent vehicle of Vostok-2 had "caught hold" of the upper layers of the atmosphere, and intense braking of it would soon begin. I on purpose had not closed one of the windows so that I could observe the picture outside of the vehicle. The rosy flame around the vehicle gradually thickens as it descends deeper into the atmosphere, becomes purple and then crimson. The heat-resistant glass is covered with a yellowish film, the steel cowlings of the window melts, and a fiery spray dashes around next to the glass windows. A thrilling picture!

After the g-loads had decreased, I felt that the vehicle was quivering slightly, and overboard I could hear the noise of the air being torn up by the vehicle. This meant that the descent vehicle had been braked down to the point where it was now moving along with a speed less than the speed of sound. The speed of the vehicle decreased from 28 thousand kilometers an hour to 600 - 800 kilometers an hour. The last stage of landing began — that of touchdown. Upon the commands of the automatic devices, the cabin hatch was jettisoned, and the catapult carried me out into the air flow similarly to how this is done in modern airplanes. The parachutes opened up and, looking around, I saw my cabin a little below me as it came close to the Earth not far from a railway which passes through in this region. To my right there was a big river with two cities on both sides of it. That meant that everything was exact, that the landing had taken place in the Saratov region.

In a little house on the steep banks of the Volga, Yuriy Gagarin, Andriyan Nikolaev, and other friends were waiting for me. But before I could have a heart-to-heart talk in the small circle of cosmonauts, I fell into the firm hands of Medicine. Questions about how I felt on the Earth, during flight. Afterwards, my replies

would be compared with the objective data of the medical examination. In the evening, I roamed about for a while with my friends on the banks of the Volga, and we spoke about the preliminary results of the flight. And on the following day we settled down to prepare the report of the state commission on the preliminary results of the flight. Yuriy Alekseyevich helped me greatly. His impressions and sensations had already been "cleansed" of emotional coloring, and now I checked my observations against what he had experienced and seen during the flight of April 12.

All of us could well imagine that flights in single-seat vehicles were only the beginning of man's studies of the cosmos. Each one of us in a single-seat vehicle was both the commander of the craft, the experimenter, the doctor, the operator, and so on. One could list many more specialties, the representatives of which remained on the Earth, but who delegated the cosmonauts to carry out a "small" assignment for them. /20

The research studies of the Soviet Vostok spacecrafts were highly concentrated, and the scope of the experiments considerably grew from flight to flight. Even after the first flights it was clear to everyone that a considerable increase in the volume of the work would lead inevitably to a division of duties among members of the spacecraft crew. In other words, single-seat vehicles would have to be replaced by multiseaters, just as the first satellite, equipped only with radio transmitters, had been replaced by increasingly complex pilotless spacecraft.

Before even two years had gone by, life confirmed the correctness of this conclusion. A new Soviet satellite-vehicle, the Voskhod, took off from the Baykonur space port. A collective went up into the cosmos on board it: the commander, who was an aviator and engineer, a cosmonaut scientist, and a cosmonaut doctor. By now the time had arrived for "specialized studies" in space. Supervision of the activities of the crew, communications with the Earth, control of the vehicle, and orientation in the basic stages

of the flight were part of the duties of the Voskhod commander, colonel-engineer V. Komarov. As a result of this flight, scientific workers in various fields of specialization were able to carry out in space joint research which was highly significant for the subsequent flights of spacecraft crews. A life-support system for cosmonauts without space suits was worked out, a system of landing without a touchdown speed of almost zero was tested, and a number of other, no less important jobs were performed.

During flights of many days, the cosmonauts carried out various observations and experiments in space, evaluated the operation of the onboard equipment in different modes of operation, and checked the means of communication and the orientation controls. This also enriched science and made it possible to outline ways of further developing technology. Experience was accumulated in using both touchdown systems - with the crew on board, and with the crew out of the vehicle.

Each new flight was a new contribution to the development of cosmonautics. March, 1965. Now the Soviet man, basing himself on the knowledge acquired, decided to leave the spacecraft cabin and take a walk into the cosmos. "It is difficult for me to write about this event without excitement," wrote Yuriy Gagarin. "And not only because on that day was accomplished something for which we had been preparing for more than a year. My great friend Aleksey Leonov became the first in the world to go out into the open cosmos. The highly complex experiment was carried out under the direction of colonel Pavel Belyaev, commander of the satellite-vehicle Voskhod-2, /21 who was also the first to carry out a manual landing of a spacecraft...."

Simultaneously with piloted cosmonautics, space research was also going ahead successfully by means of automatic devices. And this was noted by Yuriy in his speeches.



Figure 8. A. G. Nikolayev, Yu. A. Gagarin, and P. R. Popovich share impressions about their flights into space

"The development of the automatic interplanetary stations Zond, Elektron, Polet, Proton, Luna, Venera, Mars, and so forth, enabled our scientists to proceed from observation methods of studying the Universe through the thickness of the earthly atmosphere to measurements of various parameters directly in space," he wrote in 1966. "This was qualitatively a new stage in the development of science and technology.

Scientists obtained at their disposal means of studying magnetic fields and radiations in space, which had for such a long time escaped the curious glance of man. But will the study of space by means of automatic devices alone give all that is necessary?"

I have given this quotation and this question from an article written by Yu. Gagarin because we often discussed it, trying to define what exactly ought to be done in a space flight by automatic devices, and what by man, the crew of the spacecraft.

All of us, including Yu. Gagarin, were agreed that in this case it is not possible to apply a solution already found in the past. The distribution of duties will differ depending on whether the craft is orbital or intended for interplanetary flights. The flight program, the nature and scope of the scientific research, and finally, the composition of the crew will also have a great influence. However, the role played by man and his place in the control network can be indicated in terms of some of the characteristic features of control of a spacecraft.

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One of the tasks in controlling a spacecraft consists in monitoring and analyzing the state of the onboard equipment and various systems. Recall the reports from space: "All systems on the craft are functioning normally." If the work of monitoring the onboard systems is entrusted to the crew, it will spend immense amounts of time and energy in formulating an idea about such information. This part of the work can best be entrusted to automatic devices. Whenever some sort of trouble occurs, such machines will notify the cosmonauts where the trouble took place and what must be done to eliminate it. Consequently, man intervenes in the work of the automatic devices only in cases when troubles have arisen in their operation. Such an extreme necessity may not even occur during a flight.

Another example. The following units participate in controlling the orientation of the vehicle: the cosmonaut himself; the instruments determining the position of the vehicle in space and its departure from the assigned position; the indicators showing the results of measurements to the cosmonaut; the transforming and amplifying devices, the engines, and many others. The role of the human being in this is relatively simple: on the basis of the information received, he determines the task for the computing system. But here also the human being can be successfully replaced by the computer. However, the human being must be able to take over the controls of the orientation himself if need be. This is necessary, first of all, for the sake of a more rational, more operative performance of the flight tasks. Automatic devices function according to definite modes of operation. A human being can do the same thing according to different modes which better correspond to the solution of the task under the circumstances which have come about. In second place, it is necessary to increase the reliability (otherwise, should the automatic orientation system go out of order, for example, it would be impossible to disorbit the spacecraft).

Here the human being intervenes in the operation of the automatic devices only when necessary. Let us recall the flight of

Voskhod-2. After Aleksey Leonov had performed brilliantly his assigned program and had gone out into the open cosmos, when the final element of the flight - disorbiting and landing - was being carried out, one of the sensors in the orientation system failed, and the automatic control system was unable to give out the retro-thrust pulse. At this time, the "human control unit" went into operation. The commander of Voskhod-2, Pavel Belyaev, switched on the manual landing system, and the flight was completed successfully. /23

And one more example.

Recently spacecraft have been equipped with controllable descent systems. This makes it possible to lower substantially the overloads and to increase the touchdown precision. Since descent is the most responsible moment in a flight, it would be risky to entrust it only to automatic devices. The cosmonaut can duplicate the work of the automatic devices in descent and himself control the vehicle if there are any troubles in their operation. And what about docking of spacecrafts? Whereas search and distant closure of the spacecrafts can be entrusted to automatic devices, the terminal rendezvous and tethering require special attention. The cosmonaut must be able to go over quickly to manual controls if the automatic devices operate unsatisfactorily for some reason or other. In this manner, the presence of man on the spacecraft considerably increases the reliability of operation of the automatic systems.

But still, the partisans of automatic equipment may object, if it is possible to create reliable systems, it will be possible to manage even without man. Probably no one would raise any objections against this. However, it is a quite difficult matter to attain a reliability guaranteeing complete safety in flight without human intervention.

In what, then, will consist a truly reasonable approach to the distribution of functions between man and the automatic machine? /24



Figure 9. Aviator-cosmonaut colonel Pavel Ivanovich Belyayev, commander of the spacecraft Voskhod, preparing for a parachute jump. At left - Yu. A. Gagarin.

Automatic machines have to make measurements, regulate the dynamic processes and operation of the systems, monitor their state and give the crew processed information with a finished evaluation of the state of the systems, and formulate recommendations and forecasts. The crew, using these data, will analyze as a whole the state of the spacecraft and make decisions about the performance of jobs and studies during the flight.

Interplanetary spacecraft will evidently be equipped with autonomous systems of navigation. And the role played by man in them will be exceedingly great. The cosmonauts will have to determine the orbit parameters, the magnitude of the corrective impulses and the ignition time of the engines, and will engaged in solving the most diverse tasks directly connected with the success of the flight.

And so, on spacecraft the maximum use will be made of the potentialities of man in control. Already enough scientific data have been accumulated so that it can be asserted with sufficient substantiation that in space, in a state of weightlessness man is capable of doing exactly as much as he can do on Earth. In this, naturally, the maximum possible use will be made of everything achieved in the area of automatization in aviation: the autopilot, radar, and the regulation and monitoring systems which are in use in contemporary airplanes.

And what can be said about man's walks out into the open cosmos and about his transfer from one vehicle to another?

Soviet scientists and engineers have built good systems for supporting vital activity. In the cabin of spacecrafts Vostok and Voskhod-2, the cosmonauts could use either the space suit system or the pressurized cabin system. In flight, the cosmonaut could make use of either of these systems at his own discretion. If the cabin system was working, the cosmonauts could complete the flight without space suits. This was the case in the flight of the Voskhod, where the entire crew wore light garments and no space suits.

Basing myself already on practical experience, I wrote the following in the journal "Aviation and cosmonautics" in 1966:

"It must be added that transfer from one vehicle to another will be connected also with other technical difficulties. For example, with a change-over from one life-support system to another. Although the cosmonaut will be using an individual engine installation when he approaches the other vehicle, inside the vehicle he will have to transfer over to the onboard life-support system. For this purpose, it will evidently be necessary to provide a special adapter which could be switched on without stopping the supply of oxygen to the space suit."

The subsequent development of cosmonautics showed that the designers had overcome this difficulty and built a system allowing the cosmonauts to engage in extravehicular activities and enabling them to go over into another vehicle. /25

The technical facilities of transfer from one spacecraft into another or rather, from a constantly functioning space station into a vehicle intended for communications with Earth, will be widely used in the period when science has rendered near space sufficiently "habitable" and scientific research stations have appeared in orbits.

Today this is a dream, but it could become a reality soon.

Looking forward to the tomorrow of cosmonautics, Gagarin said

this about the role of automatic and piloted vehicles in space research: "It is difficult to imagine the future of cosmonautics without piloted vehicles. It is unthinkable that the cosmos could be mastered and conquered by automatic lunar and interplanetary stations alone. They unquestionably tell and will tell us much, but in my opinion these stations are only the first line of those advancing into the cosmos. Only man will be able to consolidate the victory and to maintain for himself what has been mastered."

Developing this line of thought, he wrote of the role of the cosmonauts that, step by step, cosmonauts and scientists are opening up new secrets and, consequently, making contributions towards the development of knowledge about the Earth and the Universe.

In another article, he emphasized even more decisively: "It is unthinkable that space can be mastered without aviator-cosmonauts. This is the main space profession. At first only aviators flew in airplanes, and anyone who flew above the earth was called an aviator. Multiseat planes appeared, and there were born navigators, radio operators, and flight engineers. Finally, passengers appeared. The same will happen in cosmonautics. Already the first Soviet multiseat spacecraft, the Voskhod, piloted by the aviator-cosmonaut Vladimir Komarov, had a crew consisting of a scientist cosmonaut and a doctor-cosmonaut. In time, there will be cosmonaut engineers, cosmonaut physicists, cosmonaut builders, welders, and astronomers.

"Space is a place where people of the most varied earthly specialties can apply their work and talent. There will probably be among them even the most dangerous of all specialties - the tester of spacecrafts....."

From these predictions of Yu. Gagarin there follows, with all obviousness, the conclusion which is completely incontestable for all of us: flight training on modern airplanes is absolutely essential for cosmonauts, especially for those who will pilot the spacecrafts. Yes, Yuriy Gagarin understood this splendidly and for



Figure 10. Aviator-cosmonauts of the USSR (left to right): A. G. Nikolayev, Yu. A. Gagarin, B. V. Volynov preparing films for a moving picture.

this reason exerted much effort to increase the role and authority of such training in the general /26 system of preparation. He accomplished much in this area and would have done much more had it not been for his tragic demise in March, 1968.

Yuriy left us early, very early. This man could have done for cosmonautics (I have in mind the organization of training for cosmonauts) incalculably more than he did. He had just started out

on the broad road of his professional work.

The epoch lost its hero, lost him unexpectedly, and for this reason our grief, the grief of all people on the planet was truly boundless. People in various corners of the world acknowledged their love and respect for the man of the Universe, the man who by his feat had realized their dreams, who answered for us before the entire civilized history of the planet what we had achieved in our development, affirming that the thoughts and deeds of the world's scientists from the earliest times down to our own days had been embodied in actuality, the 108 minutes of a space flight, one circuit around the planet Earth!

And naturally, everyone wanted to know why Gagarin had not been protected, why he had been allowed to fly, why he had been permitted to make this tragic flight, which was his last. The questions are legitimate if one proceeds only from love and respect for the hero of the planet.

Yuriy went into cosmonautics not for stars and rank (we never thought about this as we prepared for our flights), but rather for

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the sake of a great and important cause. "Cosmonautics, space flights," he said, "is my profession, and I did not choose it in order to carry out the first flight and then to go away...." He loved to fly and knew how to fly. After finishing school he asked to be sent to the North, where aviators are required to have special mastery in piloting, where working conditions are harsh and require constant collectedness, readiness for the unexpected, bravery, and self-control. He was accepted into the detachment of the cosmonauts. The result of the work of Yuriy Gagarin, his study and training, was the historical flight in the morning of April 12, which the peoples of the whole world called the dawn of the space era. But just as a long work day follows the dawn for us on Earth, so also in the life of Yuriy there followed ordinary work-days. As a professional pilot, he was unable to stay out of aviation work. He will be understood by pilots who have, for any reason at all, been removed from the wheel, by sailors who, after all their voyages, have been assigned to duty on land forever. He will be understood by anyone who has ever been parted from his beloved work.

The truth has been known for a long time: in order to keep up with the stormy life of our time, one must constantly learn by oneself. And in order to teach others, and still more to supervise them, one must know more than they, be able to do more than they. Yuriy was in charge of the flight training of the cosmonauts; he himself was preparing for future space take-offs and flew in modern airplanes.

The misfortune came unexpectedly. At that time I was in Italy and flew back just in time for the memorial service at the Central Palace of the Soviet Army. I cannot now express the feeling which I experienced after the contents of the newspaper information had been translated for me. Anxiety and a sense of doom, the sense that what had happened was irretrievable, a sort of abyss in my spirit, and fury at my helplessness, at the thought that I could do nothing to set anything aright, that I could not help in any way at all.

The night trip into Rome, the decision to rush at all costs,

through all obstacles, homeward, to Moscow, to Yuriy. I did not have to persuade anyone. Everyone understood, felt that I ought to be in Moscow. Those days went by in a sort of fog - Valya, the girls, the comrades, the wives. Emptiness in spirit, my heavy head humming. Unexpected splashed of memories.....the melodies of the song of Pakhmutova, "When the tired submarine out of the depths goes homeward." Yuriy had loved the song so well.

After the funeral I went to the place where Gagarin and Seregin had died, where already there was standing a stone with the inscription: "Here will be erected a monument...." At the place where the plane had crashed, there was a hole filled with clear water. Someone had thoughtfully planted it with fir-trees.

I could not tear my eyes away from the birch trees which had been left without treetops. I wanted to find out something from /28 these maimed trees about the last seconds in the lives of the gallant men who in the final moment had possibly seen this green thicket.

One year later, I came with the children and Tamara to the place where Yuriy had died. Tat'yana kept on asking: "Is this where uncle Yura died?" but Galka was still too young to understand all of this. What was Tamara thinking as she sadly gazed at the water-filled hole? Perhaps about my numerous airplane flights that year. As for me, I looked once more at the chopped-off tops of the birch trees, at the hole, and tried to understand what ever might have happened to the crew? The solemn silence, the drooping decapitated birch trees and pine trees created a sense of pain, a feeling of dissatisfaction.

How dear to me were the people who died here, precious and dear because they gave their lives to aviation and space, to their idea, their dream! I look with grief of Yuriy's daughters, little Lenchka and Galochka; I am embarrassed to talk and joke with Valya Gagarina; I recall with endless warmth the evenings I spent with Yuriy.

I don't remember how many birch trees were cut down on that tragic day. I don't know on how many trees were left traces of fragments of the airplane and the odors of kerosene. I don't know from how many birch trees were removed the remains of airplane parts. I only imagine that in this cherished silence of the virgin forest there intruded for a moment a high-pitched whistle, then the crackling of birch trees breaking, and a dull explosion, like a sigh, resounding in the depth of the forest. And then silence. The operator, following the airplane's mark on the radar indicator, still continued, by inertia, to repeat the call signs of the crew, although he knew from experience that something irreparable had happened, that something frightful had occurred, that a tragedy had taken place. He did not want to believe this and continued to broadcast over and over the call signs into the air.

But Yuriy did not leave us. He still participates as before in every flight.

Ever since the day of the launching of the first artificial earth satellite, since man's first flight into the cosmos, the mighty march of our people towards communism has been accompanied by the voice, ever growing stronger and louder, of rocket engines. The future of humanity is inextricably entwined with the conquest of space. We remember Yuriy's predictions about the paths of development of Soviet cosmonautics:

"Space flights are not an end in themselves, they are not a race for space mastery, as many write of them in the West. How wisely did Tsiolkovski put it: 'The conquest of space will bring humanity mountains of grain and immense might!' Already we see now the great results of the conquest of space."

"Cosmonautics can and must perform a great service for humanity — to open for it new worlds, to grant it power over the weather, to realize quicker communications between the continents. And cosmonautics has already taken up the task!"



Figure 11. Hero of the Soviet Union Major Yu. A. Gagarin, honored guest of the Cuban people.

In numerous speeches, Yuriy spoke of the sublime tasks of conquering space, of the various problems standing in the way of solving them.

"The day is already past when cosmonauts flew in order to find out how they felt, how their hearts beat, and what their pulse was, in order to test the bioelectric currents in the brain, whether it was possible to work in a state of weightlessness, and all the

other medical matters. Now on our agenda are more important, more serious tasks, connected with flights to other planets in the solar system, connected with the construction of big stations operating in space for a long time."

I remember how, on the eve of the 50th anniversary of the Soviet power, Yuriy was preparing, at the request of the journal "Aviatsiya i kosmonavtika," a greeting to its readers, his fellow aviators. He read out loud the almost finished text: "It was precisely this half-century," he read, "which opened up for us the way into the cosmos. The first to lay this way were Soviet people. I am confident that the future will bring us new victories in conquering altitudes and orbits. Let each one of us do everything possible for this..." Yuriy stopped, thought a bit, and continued to write: "and also that which at times seems impossible." And he signed his name boldly: "Gagarin," finishing the signature with his usual wavy line and characteristic dash.

Our aviators and cosmonauts remember this precept of their friend, the first cosmonaut. Not only do they remember; they also dream of new altitudes and orbits and are doing everything to conquer them.

Yuriy Alekseyevich, as all other Soviet cosmonauts, dreaming of new space flights, understood perfectly well that they would be incomparably more complex and difficult than those which had taken place thus far. For this reason, he worked hard and stubbornly.

"Sometimes we are asked: why is such tense work necessary? Why do we work so hard, knowing that we are wearing ourselves out with work? But when an important task, a great goal is set before people, will they think about themselves, about how much their health will be undermined, about exactly how much effort, how much energy, how much endeavor they must put in in order not to undermine their health! A true man, a true patriot, komsomol member and communist will never think of this. What is important is to carry out the task."

Yuriy Alekseyevich was a great optimist. He believed in the great future of cosmonautics, the inexhaustible powers of the Soviet people...

"The poet called our whole nation, the fatherland of cosmonautics, the 'land of youth.' I am confident that in this wonderful land, the new science about flights to the stars, which is still only gathering up its powers, will reap a rich harvest!"

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